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# BRIEFER ARTICLES

## GROWTH OF TREES IN SPHAGNUM<sup>1</sup>

Data obtained from the Puget Sound region and Alaska indicate that trees grow very slowly in sphagnum. In the habitats examined, there is no soil in the ordinary sense. The surface of the substratum consists of living sphagnum moss, just beneath which is fibrous brown peat. At greater depths decay is complete. The observations reported in this paper were all made on trees growing at an elevation of less than 750 m. Coniferous trees are more common in sphagnum than broad-leaved trees. Table I gives growth data for conifers in sphagnum and in other habitats in the Puget Sound region.

TABLE I

AVERAGE GROWTH OF CONIFERS IN SPHAGNUM AND IN OTHER HABITATS

SPECIES	SPHAGNUM		OTHER HABITATS		PERCENTAGE
	Number of specimens examined	Average annual increase in diameter	Number of examined specimens	Average annual increase in diameter	
	Diameter				
<i>Tsuga heterophylla</i> .....	13	1.01 mm.	7	1.56 mm.	64
<i>Pinus monticola</i> .....	9	0.78	11	1.34	58
<i>Thuja plicata</i> .....	11	0.60	6	1.15	52
<i>Pinus contorta</i> .....	9	0.78	21	1.57	49
<i>Pseudotsuga taxifolia</i> ...	21	0.86	16	1.69	40
	Height				
<i>Tsuga heterophylla</i> .....	11	7.37 cm.	7	17.07 cm.	43.1
<i>Pinus monticola</i> .....	9	5.39	11	8.62	62.5
<i>Thuja plicata</i> .....	11	6.45	6	18.55	34.7
<i>Pseudotsuga taxifolia</i> ....	21	6.32	16	20.93	33.1

The percentage for each species in the last column is obtained by dividing the number in the second column by that in the fourth, and therefore represents, on a percentage basis, the average amount of growth in sphagnum for the specimens examined as compared with the average growth on other soils.

<sup>1</sup> For more complete data, discussion, and literature, see Jour. Forestry, 15: 726-739. 1917.

The data on the growth of conifers in substrata other than sphagnum represented in table I were secured mainly from logged-off lands where natural reforestation was going on. All of the data for lodge pole pine and white pine, and most of those for Douglas fir, were obtained from trees growing on stony, infertile soils. A few of the Douglas firs, all of the hemlocks, and nearly all of the cedars from which data were obtained were growing on somewhat better soils, but in no case on the best class of forest soils. The data were all from young trees.

Data by foresters for larger numbers of older trees growing under the best forest conditions show much more rapid growth in all cases. Table II compares the data of the foresters with those of the writer.

TABLE II  
GROWTH OF CONIFERS IN DIAMETER OUTSIDE OF SPHAGNUM;  
COMPARISON OF DATA OF OTHER WORKERS WITH THOSE  
OF WRITER

Species	Data of other workers	Data of writer	Ratio
<i>Tsuga heterophylla</i> .....	3.60	1.56	2.3
<i>Pinus monticola</i> .....	4.68	1.34	3.5
<i>Pinus contorta</i> .....	4.80	1.59	3.0
<i>Pseudotsuga taxifolia</i> .....	9.43	1.69	5.5

Differences in the character of the soil, the amount of moisture in soil and air, and the age of the trees are doubtless among the most important factors in producing the higher rate of growth found by the foresters. The comparison merely emphasizes the fact that these conifers, even when under the most unfavorable conditions outside of sphagnum, grow considerably more rapidly than they do in sphagnum. The ratios of growth observed by the writer in sphagnum to that observed by the forestry workers under the best forest conditions is as follows: western hemlock 0.27, western white pine 0.166, lodge pole pine 0.163, Douglas fir 0.091.

It appears from these data that the western hemlock comes nearer to its normal growth in sphagnum than any other species. The ratio of its rate of growth in diameter in sphagnum to its growth in other habitats is greater than that of any other species in the regions examined. In the ratio of its growth in height in sphagnum to that not in sphagnum it is surpassed by the western white pine only. The largest specimen found growing in sphagnum has a height of 12 m. and a diameter of 45 cm. near the base. Several others have been found that approximate this in size.

It is the commonest tree in sphagnum in the Puget Sound region, individuals varying in size from 6 m. down to mere seedlings being common in nearly every sphagnum area examined. Many of the specimens, however, have some dead branches, commonly near the top. The trunks of the larger specimens show the distinctly conical form common in trees growing in sphagnum, indicating that the stunting in height is greater than that of the diameter near the base.

The Douglas fir is seldom found in sphagnum in the Puget Sound region, although it is the most abundant tree in the bordering forests. It is the lowest of the 5 species in the ratio of its growth in both diameter and height in sphagnum to that in other habitats. The largest specimens found in sphagnum are 2 m. high. Seedlings are not abundant. In so far as any conclusions can be based on these data, the western hemlock grows best in sphagnum and the Douglas fir poorest.

The other three conifers mentioned are intermediate between these two. Seedlings of giant cedar are abundant and a few trees reach a height of 5 m. The two species of pine mentioned are found in but few sphagnum areas, but occasionally an area is found in which one or the other of these species has succeeded far better than any other conifer. The Sitka spruce is a common constituent of Puget Sound forests in many places, but has been seen by the writer in only one sphagnum area.

The trees growing in sphagnum in the Puget Sound region are all erect, none being prostrated by bog conditions. That the conifers, at least, are well rooted in sphagnum is indicated by the fact that none of them are found uprooted by wind, although exposed specimens of the same species but little larger are commonly uprooted in other soils.

The only deciduous trees found by the writer in sphagnum in the Puget Sound region are red alder (*Alnus oregana*), bog willow (*Salix myrtilloides*), western dogwood (*Cornus occidentalis*), and the peat bog birch (*Betula glandulosa*). Even these are rare, and all of them except the first are so small as to be considered shrubs rather than trees.

In the forested portions of the Alaska coast some conifers are found in sphagnum. The ones most commonly found are lodge pole pine, Alaska cedar (*Chamaecyparis nootkatensis*), and Sitka spruce. These grow poorly in sphagnum. They are much distorted and are frequently sprawlingly prostrate, although they maintain their erect position and show much better growth in the neighboring forest on ordinary soil.

Along the south coast of the Alaska peninsula, where the sphagnum occurs in the forestless regions, deciduous trees and shrubs are often found in sphagnum. They are usually much stunted and in a great many

cases they are prostrate. The species found are paper birch (*Betula papyrifera alaskana*), peat bog birch, late alder (*Alnus sinuata*), and net-veined willow (*Salix reticulata*).

Toxicity of the substratum is evidently a large factor in the stunting of trees in sphagnum, although several other factors are partly responsible.—GEORGE B. RIGG, *University of Washington, Seattle, Wash.*

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### PROTHALLIA OF LYCOPODIUM IN AMERICA

Recently I described in this journal (63:66–76. 1917) the prothallia of 5 species of *Lycopodium* found near Marquette, Michigan. In that article (p. 71) I mentioned the difficulty in distinguishing between the prothallia of *L. complanatum* and those of *L. obscurum*, and a footnote was inserted to attempt to clear up a doubtful situation. In the paper, fig. 13 is named *L. obscurum*, but in the light of what follows it is evidently *L. complanatum*.

On May 27, 1917, I found several prothallia which suggested that I had not correctly identified those of *L. obscurum*. Upon following up this suggestion, on August 29 I found a small patch of sporelings of this species, and secured some 30 gametophytes with and without sporelings. They are of the *L. annotinum* type and not of the *L. complanatum* type, as stated in my paper. The excuse for the error is that hitherto the prothallia of *L. obscurum* were unknown; those of *L. complanatum* do not all grow in the same position, nor are they alike in size and color; and finally, the young sporelings of the two species are very similar.

An illustrated account of the sporeling and gametophyte of *L. obscurum* will be given in a later paper.—EARLE AUGUSTUS SPESSARD, *Marquette, Mich.*